NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

TITLE

"Interiors of the Giant Planets"

PERFORMING ORGANIZATION

Lunar and Planetary Lab., Univ. of Arizona, Tucson, AZ 85721

INVESTIGATOR'S NAME

W.B. Hubbard

DESCRIPTION *(a. Brief statement on strategy of investigation; b. Progress and accomplishments of prior year; c. What will be accomplished this year, as well as how and why; and d. Summary bibliography)*

(a) This theoretical/observational project constrains interior structure of Jovian planets through observational data. We continue to concentrate on Neptune in support of the 1989 Voyager encounter. Occultations of stars by Neptune are observed from the Tucson area and from Chile to obtain information about Neptune's atmosphere and to continue to search for Neptune arcs. Occultations by other solar system objects are also observed as part of collaborative efforts from time to time. (b) We derived new results on the structure of scintillations in the central flash occultation by Neptune on 20 August 1985 (results related to the mean light curve were published last year). Our analysis shows that scintillations are present throughout the lightcurve, both near the half-intensity points (at a pressure of 1 microbar) and near the central flash (at 0.4 mbar). Near the planetary limb, the scintillations are extended parallel to the limb, but near the shadow center, they are extended in a radial direction. We collaborated with Ramesh Narayan to derive a theory relating the scintillations to density fluctuations in Neptune's atmosphere. The theory will ultimately enable us to test whether the scintillations are caused by internal gravity waves in Neptune's upper atmosphere. We successfully observed the 9 July 1987 Neptune occultation from two stations in the Tucson area, in collaboration with G. and R. Rieke, R. Marcialis, and H. Campins. Further data on Neptune's atmosphere were obtained, but no ring arcs were detected. On 8 December 1987 we successfully observed an occultation by the asteroid Bamberga, in collaboration with a Lowell Observatory group. The resulting data will provide a more accurate determination of the asteroid's size. In collaboration with D. Tholen, we showed that geometrical optics are adequate for interpreting Pluto/Charon mutual events. (c) We will continue to carry out multistation observations of favorable Neptune occultations. The next opportunity will be on 9 July 1988, and will be observed from the MMT in the Tucson area. We are also analyzing 2-micron CCD images of 1989 Neptune positions in an effort to find future occultations of 2-micron stars which have not been discovered by shorter-wavelength photometry. Such an effort for the 1988 path found no additional opportunities.

(d) Publications

Millis, R. L., L. H. Wasserman, O. G. Franz, R. A. Nye, R. C. Oliver, T. J. Kreidl, S. E. Jones, W. Hubbard, L. Lebofsky, R. Goff, R. Marcialis, M. Sykes, J. Frecker, D. Hunten, B. Zellner, H. Reitsema, G. Rafert, E. Strother, J. Smith, H. Povenmire, B. Jones, D. Kornbluh, L. Reed, K. Izor, M. F. A'Hearn, R. Schnurr, W. Osborn, D. Parker, W. T. Douglas, J. D. Beish, A. R. Klemola, M. Rios, A. Sanchez, J. Piironen, M. Mooney, R. S. Ireland, and D. Leibow: The Size, Shape, Density and Albedo of Ceres from Its Occultation of BD +8°471. Icarus **72**, 507, 1987.

Hubbard, W. B., and M. S. Marley: Structure of the Jovian Envelope and the Equation of State of Dense Hydrogen, in Strongly Coupled Plasma Physics (H. E. DeWitt and F. J. Rogers, eds.), Plenum Publishing Co., 1987, pp. 407-413.

Hubbard, W. B., Phillip D. Nicholson, Emmanuel Lellouch, Bruno Sicardy, Andre Brahic, Faith Vilas, Patrice Bouchet, Robert A. McLaren, Robert L. Millis, Lawrence H. Wasserman, J. H. Elias, K. Matthews, J. D. McGill, and C. Perrier: Oblateness, Radius, and Mean Stratospheric Temperature of Neptune from the 1985 August 20 Occultation. Icarus **72**, 635, 1987.

Hubbard, W. B., E. Lellouch, B. Sicardy, A. Brahic, F. Vilas, P. Bouchet, R. A. McLaren, and C. Perrier: Structure of Scintillations in Neptune's Occultation Shadow. Astrophys. J. **325**, 490, 1988.

Hubbard, W. B., and Ramesh Narayan: Theory of Anisotropic Refractive Scintillation -- Application to Stellar Occultations by Neptune. Astrophys. J. **325**, 503, 1988.